

CLAIMS

What is claimed is:

1. An apparatus for controlling the flow of a process material, comprising:
  - (a) a first chamber having a rigid outer shell, the first chamber being  
5 divided into first and second regions by a flexible boundary, the  
second region being filled with a non-compressible fluid;
  - (b) a second chamber having a rigid outer shell, the second chamber  
being divided into first and second regions by a flexible boundary,  
the second region being filled with a non-compressible fluid;
  - 10 (c) an inlet flow control device arranged to provide fluid  
communication between a material input line and alternately the  
first region of the first chamber and the first region of the second  
chamber;
  - (d) an outlet flow control device arranged to provide fluid  
15 communication between a material output line and alternately  
the first region of the second chamber and the first region of the  
first chamber; and
  - (e) a chamber control device arranged to provide fluid  
communication between the second region of the first chamber  
20 and the second region of the second chamber.
2. The apparatus according to claim 1, wherein each flexible boundary is  
generally annular, thereby forming a respective inner lumen, and  
coaxially disposed within its respective outer shell, thereby forming a

respective outer lumen between the flexible boundary and the outer shell.

3. The apparatus according to claim 2, wherein the inner lumen includes the first region and the outer lumen includes the second region.
- 5 4. The apparatus according to claim 1, wherein the inlet flow control device includes at least two valves, one valve arranged between the material input line and the first region of the first chamber and another valve arranged between the material input line and the first region of the second chamber.
- 10 5. The apparatus according to claim 1, wherein the outlet flow control device includes at least two valves, one valve arranged between the material output line and the first region of the first chamber and another valve arranged between the material output line and the first region of the second chamber.
- 15 6. The apparatus according to claim 1, wherein the inlet flow control device and the outlet flow control device cooperate to ensure that each first region communicates with no more than one of the material input line and the material output line at a time.
7. The apparatus according to claim 1, wherein the chamber control device  
20 comprises:
  - (a) a conduit fluidly interposed between the first and second chambers; and

- (b) a flow control valve arranged to control the flow of non-compressible fluid between the second region of the first chamber and the second region of the second chamber.

8. A method for transferring a material from a high pressure environment to a lower pressure environment comprising the steps of:

5

- (a) arranging an input flow control device to provide a flow of material from a high pressure conduit into a first region of a first chamber;

10

- (b) arranging an output flow control device to provide a flow of material from a first region of a second chamber into a low pressure conduit;

15

- (c) arranging a chamber control device between a second region of the first chamber and a second region of the second chamber, thereby providing fluid communication between the respective second regions of the first and second chambers, the first and second region of each chamber being separated by a flexible boundary; and

20

- (d) controlling a flow of non-compressible fluid from the second region of the first chamber to the second region of the second chamber.

9. The method of claim 8 further comprising the steps of:

- (e) arranging, after a time, the input flow control device to provide a flow of material from the high pressure conduit into the first region of the second chamber;

- (f) arranging the output flow control device to provide a flow of material from the first region of the first chamber into the low pressure conduit; and
  - (g) controlling the flow of non-compressible fluid from the second region of the second chamber to the second region of the first chamber.
- 10. A method for transferring a process material from a high pressure environment to a lower pressure environment comprising the steps of:
  - (a) opening an input flow control device arranged to provide a flow of material from a high pressure conduit into a first region of a chamber intended to be filled with process material;
  - (b) opening an output flow control device arranged to provide a flow of material from a first region of a chamber intended to be emptied of process material into a low pressure conduit;
  - (c) adjusting a chamber control device arranged to control the flow of non-compressible fluid between a second region of the chamber being filled with process material and a second region of the chamber being emptied of process material thereby regulating the rate at which process material flows into and out of the respective chambers, the first and second region of each chamber being separated by a flexible boundary; and
  - (d) alternating, based on predetermined conditions, the chamber to be emptied of process material and the chamber to be filled with process material.

11. The method of claim 10, wherein the predetermined conditions for switching include a fixed time interval.
12. The method of claim 10 comprising comparing a volume of the first and second regions of at least one of the chambers.
- 5 13. The method of claim 12, wherein at least one of the predetermined conditions for switching depend on comparing the volume of the first and second regions of at least one of the chambers.
14. A flow of process material produced in accordance with the method of claim 10.
- 10 15. The flow of process material according to claim 14 wherein the process material comprises a particulate-containing material.